

* NOTICES *

Japan Patent Office is not responsible for any damages caused by the use of this translation.

1. This document has been translated by computer. So the translation may not reflect the original precisely.
2. **** shows the word which can not be translated.
3. In the drawings, any words are not translated.

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[The technical field to which invention belongs] this invention relates to the method of detection, test equipment, etc. which are used in the terminal point detection equipment of a CMP process from which the insulating layer or electrode layer on the front face of a semiconductor device in detection equipment, especially a semiconductor device manufacturing process is removed.

[0002]

[Description of the Prior Art] The significance of the technology of electrode formation, such as a multilayer interconnection, layer insulation film formation accompanying it, and a plug, DAMASHIN, is increasing greatly as the densification of a semiconductor device does not show a limitation, but is continuing progress and densification is carried out. Naturally the thickness of such a layer insulation film and a metal membrane and the monitor of a configuration (***** [being embedded correctly] etc.) serve as a big technical problem. Of course, although the monitor of thickness is needed also at processes, such as thin film formation and etching, detection of the point in a flattening process ending [process] is regarded as questionable especially recently.

[0003] When depth of focus shortening at the time of the exposure incidental to short wavelength-ization of lithography is taken into consideration, the precision demand at least of flattening of the layer intermediate layer in the range about exposure area is large. Moreover, the so-called inlay (a plug, DAMASHIN) which is the embedding of a metal-electrode layer requires removal and flattening of the excessive metal layer after a laminating. Although many methods of smoothing a layer intermediate layer locally are also proposed and performed by improvement of the forming-membranes method etc., there is a polishing process called CMP as efficient flattening technology in bigger area. CMP (Chemical Mechanical Polishing or Planarization) uses together a chemical operation (it being based on an abrasives solution and beginning to melt), is a process except the surface irregularity of a wafer, and has become physical polishing with the strong candidate of global flattening technology. concrete -- polishing-ed of an acid, alkali, etc. -- using the abrasives called slurry which distributed the polishing grain (a silica, an alumina, a cerium oxide, etc. are common) into the fusibility solvent of a member, it is suitable abrasive cloth, a wafer front face is pressurized, and polishing is advanced by rubbing by relative motion On the whole wafer surface, polishing uniform in a field is attained by making pressurization and relative-motion speed uniform.

[0004] In such a CMP process, since the stability of a process and repeatability cannot take more conventional membrane formation or more conventional etching easily, the regular detection of the thickness of a layer intermediate layer or a metal layer with feedback quick as much as possible is demanded also for process increase in efficiency. The common thickness-measurement equipment to these evaluations is used for inspection of a process in many cases. The minute blank portion (place without the two-dimensional distribution of thickness) of the wafer washed after the process was chosen as a measurement place, and it has measured by various methods.

[0005] In a polishing flattening process, there is a way change of the motor torque of wafer rotation or rotation of a pad detects friction change when polishing progresses to the purpose polishing layer and a different layer as the monitor method that feedback is more early. Moreover, an optical path is prepared in a polishing pad, or the method of measuring the thickness of the thin film under polishing by optical interference is also proposed using the light (infrared light) of wafer permeability from a wafer side.

[0006]

[Problem(s) to be Solved by the Invention] The technology which carries out the monitor of the thickness in the above-mentioned CMP process etc., such as an interlayer film and a metal layer, quickly simple, or precision improves the point ending [process] a monitor does not have the method which can be referred to as decisive, although the request is increasing. Precision with measurement sufficient in the present condition with above thickness-measurement equipment is acquired, and although reliable data are obtained, there are the following problems.

[0007] In the first place, equipment itself will become large-scale. The wafer washed after the CMP process to the second is transported to the measuring points (stage maintenance etc.) placed sufficiently stably, in order to measure, a duration until measured value is obtained is long, and feedback at a process becomes slow. The third has positioning of wafer measurement as a big problem. In the device wafer with which a pattern exists, although thickness must be measured in search of a portion without a pattern, the portion which generally does not have a pattern does not have a position fixed by the device wafer to a

very [in area] small top.

[0008] If the area of a portion without a pattern is small, although measuring range must be made small, this is not easy in equipment. Moreover, it is not easy to search for a small measuring range at high speed, and to measure it at high speed, either. for this reason -- being alike -- it is because it is necessary to have the complicated mechanism in which the picture of a pattern is incorporated and processed [recognize and] and software (an image processing -- soft) becomes that this is hard (an image pick-up element, precision alignment mechanism, etc.) and what has it [large a load and expensive] Even if realizable, the time of an image processing, position search, and positioning makes the measuring time increase greatly.

[0009] It is simple, although the method which detects the point of CMP ending [process] with motor torque is high-speed, only when detecting the polishing start of a layer which is different clearly for the moment, it is effective, and moreover, it is inadequate on precision. The optical method is learned as the method of detection of highly precise thickness or the point ending [process]. This method judges the point ending [process] by pursuing time change of the monitor light intensity which irradiates laser etc. in a wafer side and is obtained by reflection etc. Although a certain amount of [measurement / blank film / without a device pattern] precision was acquired by this method, when a device pattern (ground pattern) existed in a wafer side, it was not able to detect in sufficient precision. This problem was more more excessive than D-RAM which is a memory device in the logic element or the element of mixed loading of logic and memory.

[0010] Furthermore, the wafer moved during polishing, and the ending point of a process was undetectable by spot measurement, polishing, since the signal of the specific place of a pattern is inseparable not only from dissociating from the signal of other places of a pattern but the signal of a portion without a pattern. It solves the above problem, and the purpose of this invention has a high detection precision, and are simple thickness or a simple process end check attitude method, and offering detection equipment and the high polishing equipment of productivity further.

[0011]

[Means for Solving the Problem] The artificer investigated the cause which the point ending [process] cannot detect in sufficient precision by optical measurement, when a device pattern existed in a wafer side. Consequently, a pattern interferent component superimposes the monitor signal acquired by irradiating probe light in a wafer side on a thickness interferent component, and the size of a pattern interferent component will change, if the device pattern of a wafer changes. That is, since the size of a pattern interferent component changes corresponding to a variety of device patterns, there is a device pattern, i.e., the indeterminacy according to the kind of device, in a monitor signal. For example, between D-RAM which is a memory device, a logic element, and logic and the element of mixed loading of memory, the device of the same kind also has the indeterminacy for a pattern interferent component changing greatly with differences in a degree of integration.

[0012] Moreover, there is indeterminacy that the size of a pattern interferent component changes with places which also measure the device of the same kind by the same degree of integration. Since D-RAM this indeterminacy of whose is a memory device may consider mostly that a pattern is homogeneity as continuation of periodic structure, although indeterminacy is small, in a logic element or the element of mixed loading of logic and memory, a pattern is not uniform, and since the problem by the measuring point becomes remarkable, indeterminacy becomes large. It discovered that these indeterminacy was the causes of gross errors of detection.

[0013] An artificer came to abolish these causes of an error wholeheartedly by pinpointing the place which a device pattern measures based on the suitable parameter obtained from the monitor signal (signal wave form) as a result of research. For this reason, in this invention, it sets at the removal process of a thin film of "substrate front face in the first place. It is the method of detecting both the thickness in the aforementioned removal process, or both [one side or] ending [process] with the signal wave form of the reflected light obtained by irradiating probe light in some or all on the aforementioned front face of a substrate, or the transmitted light. The method of detection (claim 1) characterized by having the stage of pinpointing the measuring point on the aforementioned front face of a substrate, using the parameter called for from the described [above] signal wave type" is offered.

[0014] Moreover, the second is provided with "the method of detection (claim 2) according to claim 1 with which the aforementioned parameter is characterized by being the difference of the maximum maximal value of the aforementioned signal wave type, and the minimum minimal value." Moreover, the third is provided with "the method of detection (claim 3) according to claim 1 with which the aforementioned parameter is characterized by being the minimum minimal value of the aforementioned signal wave type."

[0015] Moreover, the fourth is provided with "the method of detection (claim 4) according to claim 1 with which the aforementioned parameter is characterized by being the ratio of the minimum minimal value of the aforementioned signal wave type, and the maximum maximal value." Moreover, the fifth is provided with "the method of detection (claim 5) according to claim 1 with which the aforementioned parameter is characterized by being the average of the aforementioned signal wave type."

[0016] moreover, the sixth "-- the claims 1-5 characterized by having the stage of determining thickness calculation and the point ending [process] using the reference value according to the measuring point by which specification was carried out aforementioned] further -- method-of-detection (claim 6)" any or given in 1 term is offered moreover, the seventh "-- the claims 1-5 characterized by having further the stage of performing point-of-measurement movement to a desired measuring point after pinpointing of the aforementioned measuring point -- method-of-detection (claim 7)" any or given in 1 term is offered

[0017] Moreover, the eighth is provided with "the method of detection (claim 8) according to claim 7 characterized by having

the stage of determining thickness calculation and the point ending [process] using the reference value according to the measuring point of the request to which the aforementioned point-of-measurement movement was performed." moreover, the ninth "-- the claims 1-5 characterized by having further the stage of sorting out and acquiring the signal from a desired measuring point, and determining thickness calculation and the point ending [process] using the reference value according to the measuring point by which sorting was carried out [aforementioned] -- method-of-detection (claim 9)" any or given in 1 term is offered

[0018] moreover, the tenth "-- the claims 1-9 characterized by for the aforementioned substrate front face being a semiconductor device front face in a semiconductor device manufacturing process, and the aforementioned thin film being an insulating layer or an electrode layer -- method-of-detection (claim 10)" any or given in 1 term is offered Moreover, the eleventh is provided with "the detection equipment (claim 11) characterized by using any one method of detection chosen from the method of detection according to claim 1 to 10."

[0019] Moreover, the twelfth is provided with "the polishing equipment (claim 12) which polishes the aforementioned polished member by having detection equipment and a polishing pad according to claim 11, and a polishing head holding a polished member, and giving relative motion between the aforementioned polishing pad and the aforementioned polished member."

[0020]

[Embodiments of the Invention] Although the gestalt of operation of this invention is explained below, this invention is not limited to this example. Drawing 3 is the general drawing explaining the gestalt of operation of this invention, and shows polishing equipment equipped with the detection equipment of thickness or the ending point of a process. 1 -- a polishing head and 2 -- the wafer as a substrate, and 3 -- for a translucent window and 6, as for irradiation light and the reflected light, and 17, an optical irradiation light sensing portion and 7 are [a polishing pad and 4 / a polishing surface plate and 5 / the signal-processing section and 18] displays [0021] This polishing equipment operates as follows. A wafer 2 is held at the polishing head 1, the polishing pad 3 is held at the polishing surface plate 4, and the wafer 2 is used as the 3rd page of a polishing pad pressurization 20. Polishing of the 2nd page of a wafer is performed by giving relative motion between a wafer 2 and the polishing pad 3 in the rotation 30 of a wafer 2, and the rotation 40 of the polishing pad 3, supplying an abrasives 105 between the polishing pad 3 and a wafer 2 from the abrasives feeder style 104. In order to detect thickness or the point ending [process], polishing, a translucent window is made to pass irradiation light and the reflected light 7, after the reflected light is received by the optical irradiation light sensing portion 6, signal processing is carried out in the signal-processing section 17, and the monitor of thickness information is performed.

[0022] the multicomponent wavelength light which has two or more wavelength components continuously as an irradiation light (probe light) in this invention for an optical monitor -- concrete -- the white light (or component which carried out the spectrum of it) -- using -- this -- the 2nd page of a wafer -- irradiating -- the spectrum of the reflected light of this -- terminal point detection of thickness or a process is performed by carrying out signal processing of the wave-like signal Although the method (the transmitted light can be detected in this case) which, of course, performs irradiation from a wafer side may be used, the multicomponent wavelength light source in an infrared region is needed in that case.

[0023] Moreover, the diameter of a spot of irradiation light is enlarged as compared with the smallest unit of a device pattern, and it was made for more than several round term part to be irradiated. The principle which pinpoints the measuring point of a device pattern here is explained in detail. It is considered that a device pattern is the laminating thin film pattern optically distributed in two dimensions, the reflected light can regard it as the superposition of the light wave from each class of a laminating thin film of each pattern, as drawing 6 shows typically, and that much, for the complicated interference effect, even if the light wave form has the the same thickness of the metaphor best layer, it becomes a greatly different thing from a blank film. Generally it is not easy to calculate the value of thickness to measure directly from such part light wave type. however, the thing thickness was computed by calculating beforehand the spectral reflectance from the device pattern which became predetermined thickness, and performing comparison with this and a survey reflection factor value, or the survey reflection factor value and the calculation reflection factor value were [the thing] in agreement -- with, considering as the ending point of a process is possible

[0024] Moreover, it is more practical to carry out the monitor of the ending point by making this survey wave into a reference (desired value) with the wafer of a dummy used at various processes, when the actual measurement of the spectral reflectance of a desirable sample can be obtained, and it is simple. In case the wafer with which the pattern was formed is measured, a pattern is a single dimension or a 2-dimensional periodic pattern, irradiation area is fully larger than the area for a pattern's round term, and when the pattern is distributed over homogeneity over the whole wafer surface (the pattern of D-RAM etc. hits this.), as average information, it is stable and it is checked that the reproducible signal by the place is acquired. in this case, the so-called in-line which measures a wafer after a process the in-situ measurement measured in process also in measurement -- also setting -- a measuring point (irradiation position) -- it is not necessary to mind -- a spectrum -- it is possible to compute thickness or to get to know the ending point of a process from a wave However, by things, such as CPU with an uneven distribution of a pattern, and ASIC, part light wave type changes greatly with irradiation positions, and it just stated above that it becomes impossible to take the repeatability by the irradiation position.

[0025] In devices, such as CPU and ASIC, in many cases, although it is an uneven pattern, it can divide into some blocks separated functionally. The artificer actually checked that the repeatability of the signal within each block is good, and that part light wave types differed greatly between blocks in various devices. It is considered to be based on the following

situations that such signal change takes place. That is, in a certain block, usually regularly, I hear that the definition (average pitch) of the pattern is of the same grade, and the device circuit pattern in it has it, even when not necessarily regular. This is appropriate also from the efficiency of a device production process.

[0026] The artificer analyzed the signal wave form (a spectral reflectance or a spectrum wave) from a pattern, and has noticed the configuration of these waves being greatly dependent on the definition of a device pattern. Conversely, if it says and a definition will be the same grade, I hear that it becomes the almost same part light wave type, and it is. Naturally in measurement by perpendicular light incidence, thickness and pattern density also influence a wave. Pattern density is the ratio of the area of the heights in the layer occupied in the whole area here. Moreover, generally heights are the dielectric films on a metal layer (transparent membrane). since [however,] it is [in / the usual device / about thickness, it is almost the same all over a wafer on a process, and] within fixed limits (30 - 50%) also about pattern density -- these spectra -- the artificer observed that the influence affect wave-like place dependence was not in fact so big As influence affect the whole wave, it was a portion with a fine memory cell portion etc. (drawing 1 -a), and the coarse portion (drawing 1 -b) of pattern pitches, such as the wiring section, in a certain device pattern that a definition is larger than pattern density, and although thickness and pattern density were almost of the same grade, they were found also from the clear wave difference having been accepted. A wave-like configuration is presumed to be what is depended on the difference in the interference phenomenon of the reflected light as a cause which depends on the definition of a device pattern greatly. As shown in drawing 6 in instantiation, in the reflected light from the laminating thin film pattern which is a device pattern, the interference between patterns (interference of wavefront splitting) is added with the interference phenomenon (interference of amplitude splitting) by thickness. Since the interference by this pattern is the phenomenon of the patterns only in the coherence length (space) of irradiation optical system, when pattern width of face is larger than a coherence length, it does not take place. Part light wave type is determined by mere help doubling of the optical intensity from each part by the pattern with it. [large namely, pattern width of face and] [coarse] Validity was confirmed when this presumption compared the above-mentioned survey data etc. with interference of amplitude splitting, interference of wavefront splitting, and the simulation calculation result by modeling of coherence length etc.

[0027] In this invention, such a phenomenon is used, and an irradiation position is known with the part light wave type obtained from the wafer which has a device pattern, and it aims at taking the repeatability of measurement. That is, if it irradiates whether it is that irradiation light is irradiated on a device pattern by part light wave type, it will judge which portion on a device pattern (for example, A, B, C, D, E, F of drawing 2) the irradiation position is, and an irradiation position is pinpointed, and the method of calculation (model calculation) of thickness is changed according to an irradiation position. Moreover, the target wave of the point ending [process] is also chosen according to an irradiation position. Thus, when every position is being irradiated while irradiation light polishes, detection of thickness or the point ending [process] is performed and it becomes possible to control a process.

[0028] the position where irradiation light is irradiated to the above method -- a spectrum -- the spectrum which acquired in the case of the equipment which had the mechanism in which an irradiation position is changeable although having detected by specifying from a wave and making preparations of two or more calculation methods or a target wave corresponding to each position on a device pattern -- it is possible by analyzing a wave by time series to also perform the optical irradiation to a desired position

[0029] Moreover, in-situ which measures while performing a polishing process In measurement, by this method, control of an irradiation position cannot be performed but the data from various positions are acquired continuously. Even in this case, with part light wave type, judgment specification of the irradiation position is carried out, and process control becomes possible by processing data according to an irradiation position. It is sorting out and processing only the data from the always same position (for example, any of A, B, C, D, E, and F of drawing 2 are their?), or distributing the data from various positions (for example, A, B, C, D, E, F of drawing 2) for every position, and processing them in each position.

[0030] A parameter desirable although judgment specification of the irradiation position is concretely carried out from part light wave type is listed to below.

1. the ratio of the difference 2. minimum minimal value of the maximum maximal value and the minimum minimal value, and the maximum maximal value -- any which were chosen from the parameters more than the 3. minimum minimal value, or one or more -- using -- a spectrum -- carry out judgment specification of the irradiation position by comparing the value over which parameter obtained from the wave by signal processing with the value which was calculated from simulation calculation or measurement from a different pattern position, and was memorized in advance

[0031] As mentioned above, although this invention was explained about the dielectric film (layer insulation film), also in measuring-point judgment of a metal membrane, this invention can apply it. That is, in case electrode layer embedding (inlay) forms, when removing the metal by which the laminating was carried out to the whole surface by etching or polishing generally, a portion with a metal layer and the portion which is not appear at the time of a process end. The part light wave type of the reflected light is usually smooth in a metal membrane. If a metal membrane is lost and a pattern appears, the influence of a ground dielectric layer will be received and part light wave type will change a lot. By observing this change, it is effective in judgment of the measuring point to the metal membrane of each pattern.

[0032] a spectrum -- if judgment specification can do an irradiation position from a wave -- a degree -- a spectrum -- although it asks for a suitable parameter by signal processing from a wave and the monitor of the point ending [process] is performed using this, it is desirable any which were chosen from the following parameter as these parameters or to use one or more

1. Maximal Value or Minimal Value -- or (Maximal Value-Minimal Value) -- or (Minimal Value/Maximal Value) -- from -- the Selected or More 12. Maximum Maximal Value -- or the minimum minimal value -- or (the maximum maximal value-minimum minimal value) or (the maximum minimal value / the maximum maximal value) -- from -- selected or more 13. distribution 4. -- by simulation calculation beforehand remembered to be the component 5. part light wave type of the suitable Fourier transform In common, and it may differ from the parameter used for judgment pinpointing of a measuring point. [the parameter used for detection of the point with the obtained part light wave type ending / cross-correlation-function polishing]

[0033] Moreover, although the equipment used for a removal process was used as the polishing equipment of drawing 3 with the gestalt of this operation, it cannot be overemphasized that this invention can otherwise be used for the removal process by ion etching etc. It can do at high speed farther than the position judgment method by each judgment by the above method carrying out the image processing of the general picture which picturized and incorporated the pattern, and a mechanism also becomes easy far.

[0034] [Example] [Example 1] It is actually the layer insulation film SiO₂ of the image pck-up element on a 6 inch wafer. It polished with the polishing equipment shown in drawing 3, and the polishing end check appearance was tried. The polished image pck-up element has the block structure as shown in drawing 2, each position of A, B, and C is the high portion of definitions, such as an element and capacity, and each position of D, E, and F is the low portion of definitions, such as wiring. about 2cmphi of optical irradiation is circular like drawing 3 to the polishing pad 3 (epoxy system abrasive cloth) and its polishing surface plate 4 at the bottom -- we opened the hole and decided to carry out with the composition which formed the translucent window 5 which equipped the same field as the 3rd page of a polishing pad with the quartz The 2nd page of a wafer is made to shoot a xenon lamp perpendicular ON, as shown in drawing 4, an optical irradiation light sensing portion carries out wavelength decomposition of the reflected light after pinhole 15 passage (removing the scattered light and the diffracted light) and with a diffraction grating 13, and as the light of different wavelength in the different direction goes, it detects it by the optical diode type linear sensor (512 elements) 14. About 400nm to 800nm and the irradiation spot system of the measurement wavelength range are about 2mmphi. The output from a sensor is sent to the signal-processing section 17, and is processed. the spectrum beforehand measured by the signal-processing section 17 to the pattern of this image pck-up element -- the reference information obtained from the wave is memorized and it is used as a reference value of signal processing

[0035] The thing which made the alkali solvent distribute a silica grain is used for an abrasives (slurry), and it is about 100 g/cm². It polished by *****. The influence (mainly scattering loss) on the quantity of light by slurry mediation was 1% or less. The equipment of a more than performed preliminary measurement to the wafer sample of the same configuration as the wafer (image pck-up element) of a product first. To the maximum front face, it is about 1000nm insulator layer SiO₂ which carried out CVD membrane formation. It polishes. When polishing which carries out a polishing end by the thickness of about 500nm was performed, the obtained part light wave type was observed and each portion of A, B, and C irradiates Becoming a configuration like drawing 5 -a, the signal from each portion of D, E, and F became a form like drawing 5 -b, and became a thing reflecting the definition of each position (block). It supposes that the portions of A, B, and C are considered as block 1, and the portions of D, E, and F are classified from wave-like similarity with block 2, and this wafer sample is received. from polishing thickness zero to predetermined polishing thickness Although these values had a big difference between the block 1 and the block 2 when it measured and the difference of the maximum maximal value and the minimum minimal value was searched for from the block 1 and the block 2, after polishing for every predetermined polishing thickness Since there was no big difference for every polishing thickness, the suitable constant value for block distinction was defined between the value over block 1, and the value over block 2, and it memorized as reference information. The thickness or the ending [polishing] point judgment information acquired from the difference of the maximum maximal value to block 1 and the minimum minimal value in addition to this as reference information was also memorized.

[0036] The image pck-up element of the same configuration as what was used for preliminary measurement as a wafer of a product is chosen, and it is about 1000nm insulator layer SiO₂ which carried out CVD membrane formation to the maximum front face. It polished. The difference of the maximum maximal value of the part light wave type under polishing and the minimum minimal value was taken, and when it was more than the constant value memorized as reference information, in block 1 and except [it], judgment specification was carried out with the block 2.

[0037] The monitor did not carry out to the deed and the block 2 only to the block 1, using the difference of the maximum maximal value and the minimum minimal value as a polishing end check delivery-volume parameter. During advance of polishing, the difference of the maximum maximal value and the minimum minimal value changed, by comparing this value with thickness or ending [polishing] point judgment information, judged the polishing end and ended polishing.

[0038] When some wafers of the product which carried out the polishing end were actually observed, flattening of the front face was carried out and it has checked that polishing was made with about 3% of error to about 500nm target *****.

As a parameter for the monitors of the point ending [example 2] polishing], it measured by the same equipment as an example 1, and the method except using not a difference but the cross correlation function of the maximum maximal value and the minimum minimal value.

[0039] For this reason, the part light wave type of block 1 to the point ending [polishing] was memorized as reference information as thickness or ending [polishing] point judgment information. Distinction specification with block 1 and block 2 was performed like the example 1. The monitor of the point ending [polishing] did not carry out to the deed and the block

2 only to the block 1 like the example 1. The cross correlation function with the part light wave type to the point memorized as the measured part light wave type value and reference information during advance of polishing ending [polishing] was calculated, and polishing was ended for the time of this correlation coefficient increasing rapidly.

[0040] When some wafers of the product which carried out the polishing end were actually observed, flattening of the front face was carried out and it has checked that polishing was made with about 3% of error to about 500nm target *****.

The minimal value of [example 3] part light wave type was made into the parameter for measuring-point judgment, and it measured by the same equipment as an example 1, and the method except determining ** for the case where this becomes below constant value as block 2 in the case of beyond block 1 and it.

[0041] During advance of polishing, the difference of the maximum maximal value and the minimum minimal value changed, by comparing this value with thickness or ending [polishing] point judgment information, judged the polishing end and ended polishing. When some wafers of the product which carried out the polishing end were actually observed, flattening of the front face was carried out and it has checked that polishing was made with about 3% of error to about 500nm target *****.

By measurement of the [example 4] example 1, and the method (judgment by the difference of the maximum maximal value and the minimum minimal value) of the same mechanism and same position detection, the metal layer (aluminum layer) was polished by CMP, and the monitor of the process which carries out plug formation was performed. At the time of a polishing start, it is the form where the metal layer was wearing the whole polished field surface, and if the reflected light is observed, in general flat part light wave type will be obtained. In part light wave type, the maximum and the minimal value appear according to the interference effect as polishing advances and an insulating layer is exposed. Judgment specification of whether it is block 1 or it is block 2 was carried out by comparing with the constant value which measured beforehand the difference of the greatest thing of this maximal value, and the minimum thing of the minimal value with the test wafer, and was memorized as reference information.

[0042] The monitor has detected the point ending [process] efficiently by comparing with the difference of the maximum maximal value of a target wave and the minimum minimal value which had a deed and this parameter memorized only to block 1, using the difference of the maximum maximal value and the minimum minimal value as a polishing end check delivery-volume parameter.

[0043]

[Effect of the Invention] If this invention is followed as above, since pinpointing of a measurement position can be performed at high speed simple in thickness measurement of a device wafer, repeatability of measurement is realized, detection of polishing thickness and the point ending [process] can be performed at high speed with high precision, and process control can be performed efficiently quickly.

[Translation done.]